

# Variables

Chemical and physical changes are affected by many variables. Variables are factors which alter the rate of a chemical or physical change. Examples of variables are temperature, concentration, surface area, stirring, and crushing.

Concentration affects the rate of chemical and physical change. Generally, increasing the concentration increases the rate of chemical or physical change. For example, strong winds increase the burning in a fire. Oxygen supports burning. Strong winds increase the concentration of oxygen available to the fire. Strong winds make fighting a forest fire very difficult partly because there is a high concentration of oxygen to support the burning.



Analyze the effect that temperature has on mixing by doing the following activity:

1. Fill one clear glass with 1 cup of cold water.
2. Fill another clear glass with 1 cup of hot water.
3. At the same time add one drop of food coloring to each cup.
4. Observe.
5. In which glass did the food coloring mix faster?
6. How does the temperature effect the mixing rate?

Surface area also affects the rate of physical and chemical change. Surface area has to do with the number of exposed surfaces available for physical or chemical changes to take place. Look at the pictures below.



Does the sugar cube have more or less surface area than the group of sugar crystals? Of course the sugar crystals have more surface area. Each surface of each crystal is exposed. In the sugar cube many of the sugar crystals are not exposed until the outer crystals on the cube have dissolved. So the rate of physical or chemical change will be faster with the group of sugar crystals due to increased surface area.

Stirring is another variable affecting the rate of physical or chemical change in substances. How long would it take to make Koolaid if you put the sugar, flavoring, and water in a pitcher and then let it sit on the counter? What if you stick a spoon in the mixture and stir it? Which drink mix would be ready to drink first? Stirring brings substances together so they can react and/or mix quickly. Stirring increases the rate of chemical and physical change.

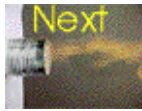




Crushing affects the rate of physical and chemical change. Knowing what you do about surface area, how might crushing affect the rate of physical and chemical change? Look below at the two denture cleaner tablets.



Which one will react in water? Both, of course. Which one would react more quickly? You are correct if you said the crushed tablet would react more quickly. The increased rate of reaction is due again to the increased surface area of the crushed tablet.



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